Fact Sheet #5

Stormwater Technology: Vortechnics® Stormwater Treatment System

February 2003

*The **Vortechs® Stormwater Treatment System Fact Sheet** is one in a series of fact sheets for stormwater technologies and related performance evaluations, which are undertaken by the **Massachusetts STrategic Envirotechnology Partnership (STEP).***

The STEP evaluation, *Technology Assessment Report, Vortechs® Stormwater Treatment System, Vortechnics Inc. Scarborough, ME*, October 31, 2002, is the information source for this fact sheet. When a more thorough understanding of this system is required, the full *Technology Assessment Report* should be reviewed. Copies are available for downloading from the STEP Web site (www.STEPSITE.org/) or by contacting the STEP Program (Phone: 617/626/1197, FAX: 617/626/1180, email: linda.benevides@state.ma.us). The information in this fact sheet is subject to future updates as additional performance information becomes available.

Description/Definition

The Vortechs® system removes sediment, oil, and grease from stormwater runoff, and provides higher TSS removal efficiencies than oil and grit separators. The system consists of a concrete box with inserts that divide the unit into functional treatment chambers for grit settling, oil removal, flow control, and stormwater discharge. Starting with the cylindrically-shaped grit chamber, sediment is removed from the influent flow by gravitational settling, which is enhanced by a vortex created in the chamber. Runoff then enters the oil chamber through an opening in the wall of the grit chamber, where oils and other floatables are separated from the flow by a baffle wall. The flow control chamber maintains the water level in the system while allowing peak flows to discharge without upstream surcharging. Ultimately, treated runoff is discharged from the last chamber to the stormwater pipe conveyance system.

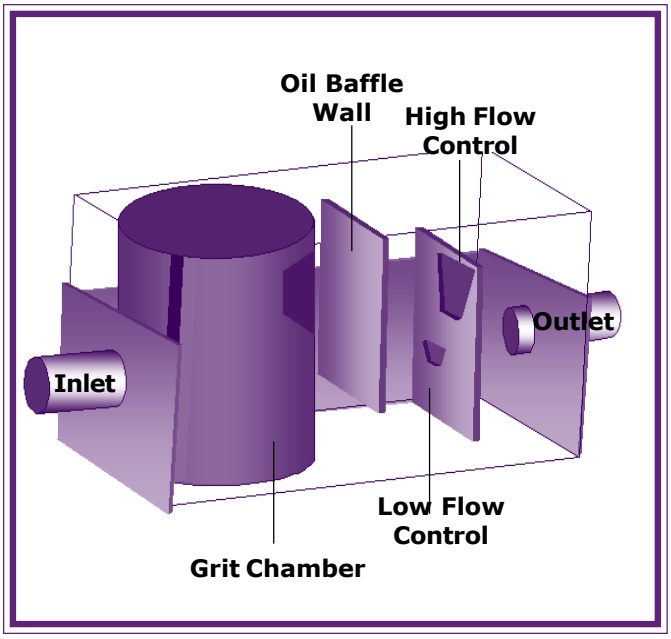

Figure 1. Schematic of a Vortechs® System.

Equipment and Sizing

Systems are designed to be installed below grade and require an inlet structure upstream and an outlet structure downstream. Systems without a peak flow bypass are referred to as "on-line" systems. The Vortechs® system also can be constructed with a bypass for an "off-line" system.

Nine standard sizes of the Vortech® systems are available (See Table 1). They can be designed to remove a specified percentage of suspended solids on an average annual load basis, when operated and maintained properly, and may be an element of a stormwater treatment system that is designed to comply with the Massachusetts Stormwater Management Policy. More detailed information on sizing can be found in the Technology Assessment Report.

Performance/Effectiveness

Data from laboratory and two field tests were evaluated to determine Vortechs® performance capabilities on suspended solids removal. A full description

of the test results also is in the Technology Assessment. Because the studies evaluated were based on testing that does not conform with the Stormwater Best Management Practice Demonstration Tier II Protocol (2001), this fact sheet will be revised when performance data are available from testing in conformance with the Protocol.

Laboratory testing of a full-scale Vortechs® Model 2000 determined removal efficiencies for particle sizes between 38 microns and 450 microns and flow rates from 10 to 100 gpm/ft^2 grit chamber areas. Results indicate that removal rates decrease as particle sizes decrease, and as flow rates increase. The laboratory test results were used by Vortechnics to develop their sizing criteria.

Two phases of field testing were conducted by the vendor using a model 11000 (on-line configuration in Yarmouth, ME) treating flow from a 4-acre, 300-car parking lot and a highway drainage swale. In Phase 2, Vortechnics monitored the system for 20 events between May and November 1999. The average total suspended solids (TSS) removal efficiencies calculated by four different methods ranged from 60 to 83 percent. Efficiencies also were calculated for the last 10 events only, because of flow metering problems during the first 10 events. Removal efficiencies for these events ranged from 40 to 59 percent.

The second field test was conducted using a model 11000 (off-line system in Lake George, NY) treating flow from a 9.34 acre site, which is about 95 percent impervious. The New York Department of Environmental Conservation monitored 18 storm events in 2000; however, the extent of bypass flow was not quantified. The removal efficiency for the events ranged from 72 to 90 percent using four different computation methods. Approximately 95 percent of the material removed was within a sand sized particle range, from 50 microns to 2mm. These results included potential sources of error relating to sampling quality control, equipment calibration, and the methodology used for calculating influent and effluent mean concentrations.

When designed correctly, new installations in areas with similar rainfall, land use, influent concentrations, and flow characteristics may have comparable removal efficiencies to those included in the Technology Assessment.

Technology Status

The Vortechs® system is designed to provide separation of sediment, oil, and grease from stormwater by routing runoff into a low-turbulence environment where solids settle and oils float out of solution. Vortechs® systems are among the category of hydrodynamic separators, which are flow-through devices with the capacity to settle or separate grit, oil, sediment, or other pollutants from stormwater. According to the U.S. Environmental Protection Agency, "Hydrodynamic separators are most effective where the materials to be removed from runoff are heavy particulates - which can be settled - or floatables - which can be captured, rather

Model Number	Approximate Size L x W ft x ft	Grit Chamber Diameter/Surface Area ft/ft^2	Peak Design Flow[2] cfs	Sediment Storage[3] yd^3	Sediment Storage[3] yd^3
1000	9 x 3	3/7	1.6	0.75	20.25
2000	10 x 4	4/13	2.8	1.25	33.75
3000	11 x 5	5/20	4.5	1.75	47.25
4000	12 x 6	6/28	6.0	2.5	67.50
5000	13 x 7	7/38	8.5	3.25	87.75
7000	14 x 8	8/50	11.0	4	108.00
9000	15 x 9	9/64	14.0	4.75	128.25
11000	16 x 10	10/79	17.5	5.5	148.50
16000	18 x 12	12/113	25.0	7.0	189.00

Table 1. Vortechs® Sizing Chart (Vortechnics 2002)

1. The sizing information is representative of typical Vortechs® systems.
2. For inline systems without a bypass. Sizing is based on 1 square foot of grit surface/ 100 gallons per minute of peak design storm flow rate.
3. Sediment storage volumes assume a 3-foot sump and a 1-foot opening under the baffle.

than solids with poor settleability or dissolved pollutants." Additional testing is needed to determine system effectiveness at immobilizing oil and grease, and to quantify the untreated sediment loads that are bypassed by off-line Vortechs® systems.

The field studies evaluated for the STEP verification predate the Stormwater Best Management Practice Demonstration Tier II Protocol (2001), which is applicable in Massachusetts and other states in the Technology Acceptance Reciprocity Partnership (TARP), to ensure development of quality controlled studies that can be shared among participating states. Interstate reciprocity is not available to Vortechnics, based on performance claims that were reviewed in the Technical Assessment. If the TARP Protocol requirements are fulfilled in the future, the manufacturer could pursue reciprocal verification for Vortechs® systems in participating TARP states. More information on the TARP Protocol is available on the following Web site: www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp. It is recommended that any additional field research and new data collection for confirming Vortechs® system performance be undertaken using a higher level of quality control.

Using the protocol of the Environmental Technology Verification Program of the Environmental Protection Agency and NSF International for wet weather flows technologies, third-party testing of Vortechs® systems is being conducted in Milwaukee, WI. This fact sheet may be updated when results from this study are available.

Applications/Advantages

- Removal efficiencies were highest when particles were large (greater than 63 microns) and flows were slow (less than 20 - 30 gallons per minute per square foot).
- The Vortechs® units are suitable for new and redevelopment projects, where space is limited.
- Vortechs® systems also can be used for a wide range of drainage area sizes, provided that the system is sized and sited correctly.
- The Vortechs systems, in combination with other treatment systems, can be used to fulfill the requirements for 80 percent TSS removal (Standard 4) and for recharge to groundwater (Standard 3), as a pretreatment device.

Considerations/Limitations

- Vortechs® systems are not expected to provide significant removal of nutrients (nitrogen and phosphorus) or pathogens, such as fecal coliform.
- The systems are not on the list of approved BMPs for critical areas, such as public drinking water supplies, certified vernal pools, public swimming beaches, shellfish growing areas, cold water fisheries, and some Areas of Critical Environmental Concern (ACECs). However, the systems can be used as pretreatment devices for approved BMPs. The structural BMPs approved for use in critical areas are described in Standard 6 of the Stormwater Management Policy, www.state.ma.us/dep/brp/stormwtr/stormpub.htm.
- The TSS load bypassed by the off-line system in the Lake George, NY study was not evaluated. Only the TSS removed by the unit was quantified.
- Oil and grease removal claims made by the manufacturer are not evaluated in the Technology Assessment.
- Systems require regular maintenance to minimize the potential for washout of the accumulated sediments. Personnel entry into the system would be subject to confined space safety procedures.

Reliability/Maintenance

Vortechs® systems require frequent maintenance to prevent washout of accumulated material. Visual inspection of the system's interior should be done after storm events and at least quarterly in the first year to develop an understanding of the load build up and maintenance needs. The manufacturer recommends cleaning when material is within six inches of the dry weather water level and when oils and greases are floating on the water surface. Access for cleaning is through a manhole opening in the top of the system. It is recommended that material in the treatment chamber be pumped out by a vacuum truck.

References

Winkler, E.S. and Susan Guswa. "Technology Assessment Report, Vortechs™ Stormwater Treatment System Vortechnics Inc., Scarborough, ME," University of Massachusetts, Amherst, MA. 2002.
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United States Environmental Protection Agency. "Storm Water Technology Fact Sheet Hydrodynamic Separators." EPA 832-F-99-017.

Vortechnics Web site: www.vortechnics.com